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Attachment F

ACCUMULATION OF ARTICLES

RELATING TO

THE IRIDIUM SYSTEM

(JULY - DECEMBER 1990)

LEVEL 1 - 1 OF 53 STORIES

Aerospace America

December, 1990

SECTION: AEROSPACE 90; Pg. 30

LENGTH: 1234 words

HEADLINE: Space systems

BYLINE: by Edward Reynolds

BODY:

Space science and exploration took a giant step forward this year. Two of four planned great telescope observatories were launched by the U.S. The first planetary space probe since Pioneer Venus went into orbit around Venus and began returning science data. A space probe to study the Sun from a new angle was launched, and President Bush outlined a schedule for sending a piloted mission to the Moon and Mars.

President Bush announced a new "Age of Exploration," culminating with landing a person on Mars by 2019. As an initial step, a lunar outpost would be built by 2004. The price was assessed by NASA at $ 400 billion. Other less costly but more risky approaches are being considered. President Bush has to resolve funding with Congress before the program starts.

Despite being grounded for five months this summer, the Space Shuttle had a busy year. Columbia recovered the Long Duration Exposure Facility (LDEF) in January, shortly before it would have spiraled down into the atmosphere to a fiery and unproductive end. In orbit since 1984, LDEF will provide important data about materials longevity for the future design of spacecraft structures and coatings. LDEF also involved students in the space program by carrying tomato seeds for study after being exposed to space. When the time came to distribute seeds to schools, fears were aroused about "mutant tomatoes." So far, no dangerous vegetables have been spotted.

The Hubble Space Telescope was launched in April to the fanfare that big science was blossoming. After years of waiting, the first of four great observatories in the works reached space and began sending back data. Despite a spherical aberration in the main mirror, surprising discoveries are being made. In August, Hubble revealed a bright ring of hot gas around the remnants of Supernova 1987A. Images better than those from any ground-based telescope, despite the mirror flaw, are giving clues about the core structure of galaxies. Astronomers still hope that Hubble in its present state will aid them in their search for evidence of black holes in the centers of galaxies. Hubble has also found in a galaxy 40-milion light-years away the second densest concentration of stars known.

Present thinking is to replace Hubble's main camera with one compensated for the spherical aberration in a few years. Computer image processing has been able to partially reduce the effects of blurring.

This month, Columbia is to launch the Astro mission, which carried three ultraviolet and one X-ray telescope. Instruments were mounted in pallets in the cargo bay and controlled by four astronomers working around the clock in two teams to observe exploding galaxies, supernovas, and black holes. Astro also helped pick celestial targets for Hubble.

In October, the Shuttle launched the Ulysses spacecraft. It will study the Sun, and in particular will fly out of the ecliptic to sample the interplanetary medium there and sight the solar poles.

In November, the Gamma Ray Observatory (GRO) was scheduled to follow Hubble as the second of the four great observatories to reach space. Very heavy at a whopping 35,000 lb, GRO has one instrument that weighs over 4,000 lb. With four instruments, GRO will map the universe across a spectrum that until now has been little explored. Also, the observatory will be useful in the study of black holes, pulsars, and quasars. Observations will be made simultaneously with Hubble.

Space Station Freedom spent the summer and fall undergoing preliminary design review.

NASA's budget for 1991 looks good. While other government agencies are taking cuts, NASA will get 17% more money than in 1990.

If interest is any indication, the lightsat industry must be doing well. This year's attendance at the annual lightsat conference in Logan, Utah, was 400, up from 250 last year. At the conference, Motorola proposed launching a constellation of 77 lightsats for worldwide cellular telephone communications. Dubbed Iridium, the project would truly adopt the lightsat philosophy of gaining economies of scale and turning out satellites in factories. Using cellular telephones, users would be able to call anywhere in the world for $ 3-4 per minute. Cost of Iridium is estimated at $ 2.3 billion.

TRW has contracted to build up to 12 lightsats, each weighing less than 1,000 lb, for the Air Force Space Test Experiments Platform science program starting in 1992. That lightsats have found real needs and customers shows how serious and mature the industry is becoming.

As an additional lift for the lightsat industry, major launch vehicle companies are designing secondary payload adapters to allow piggybacking lightsats with larger spacecraft on big rockets. At the Utah conference, adapter designs for Titan, Delta, and Atlas were presented. This year, two Uosat spacecraft and four microsat spacecraft in an adapter accompanied a Spot 2 satellite on an Ariane launch. Perhaps the lightest lightsat this year was one of these microsats, which weighed a mere 22 lb.

Lightsats got a big shot in the arm this year with the successful launch of the Pegasus rocket in early April. The Hercules/Orbital Science winged booster placed two lightsats into low Earth orbit. Dropped from under the wing of a B-52, the craft took flight just off the coast of California. Pegasus can place over 500 lb of payload into low Earth orbit from virtually any launch point.

U.S. commercial launches went well, numbering at least a dozen, up from just a couple last year. This impressive series of launches started just hours into the year, by Greenwich time, with the firing of a Titan III. Over the next

several years launches should average 16-20 per year. American companies expect to capture almost half the market in a few years.

American launch vehicle companies are still concerned about the fairness in competition for selling launch services. The USSR, China, and other countries continue to subsidize launch costs, while the U.S. does not.

Two launch failures were turned into successes. Two communications satellites launched in 1984 into useless orbits and recovered that same year were relaunched successfully this year. They were orginally launched together from the Shuttle but failed to reach proper orbits when each of their Payload Assist Modules failed. In November 1984, a Shuttle recovered the pair, and Hughes refurbished them. In March, Westar 6 was launched as Asiasat by a Chinese Long March 3, and Palapa was launched for Indonesia by a McDonnell Douglas Delta II. Hughes and NASA are discussing recovering another satellite in a useless orbit for relaunch.

As a sign of how much times have changed, the AIAA Space Systems Technical Committee spent a week touring Soviet space facilities, including Star City and Mir and Buran flight control centers near Moscow, and the Baikonur launch site in Kazakhstan. At Star City, they were shown the cosmonaut training facility, including the Mir mockup and an underwater 0-g simulator. At Baikonur, they saw the Buran shuttle, the Energiya booster, a half-completed new shuttle, and the launch complex from which Sputnik and Yuri Gagarin were orbited. Many times the Soviets expressed interest in commercial and international space ventures. Some even reminisced on the Apollo-Soyuz mission as the "good old days."

GRAPHIC: Picture 1, The Astro mission to be launched this month will carry three ultraviolet and one X-ray telescope. Instruments were mounted in pallets in the cargo bay.; Picture 2, A Pegasus air-launch space booster drops from under the wing of a NASA B-52 on its first launch.

LEVEL 1 - 2 OF 53 STORIES

Aerospace America

December, 1990

SECTION: AERO-SPACE '90; Pg. 68

LENGTH: 1394 words

HEADLINE: Communications

BODY:

Global communications has entered a period of rapid change. Growth in the quantity and diversity of communications satellite services and the spread of fiber optic cables are making the marketplace hop. Technology from military communications is now entering commercial services. During the '90s regions of the electromagnetic spectrum will be opened, and services in presently used regions will be upgraded by new modulation techniques.

Fiber optic cables are taking away telephone traffic but satellites are more than making up for the loss with more video distribution, customer premises very small aperture terminal services, news gathering, and mobile communications. It will be many years before a fiber cable reaches into every home, whereas direct broadcast from satellite to home is available throughout the world and especially in Europe.

New technologies hold the keys to lower cost and more diverse communications services. A growing stable of expendable launch vehicles should increase access to space. Small satellites should get a cheaper ride to orbit on Orbital Sciences' Pegasus booster, which was air launched in April from under the wing of a B-52. Lightsat technologies and the NASA Advanced Communication Technology Satellite (ACTS) will stimulate what is the most mature example of space commercialization.

Communications techniques such as time division multiple access (TDMA), spread spectrum modulation, and multiple access protocols are permitting more intensive use of scarce spectrum resources. Technologies such as transmitters and receivers in Ka-band are opening up a new region of the spectrum. Array antennas with stationary or hopping beams will allow geographically separated users to transmit on the same frequencies. Onboard processing made possible by monolithic microwave integrated circuits and hybrid microwave integrated circuits increasingly approaches the ideal of the switchboard in the sky.

Also, solid state devices lower the cost of ground stations. High-efficiency power GaAs field effect transistors for solid state power amplifiers, and higher power linearized traveling wave tube amplifiers raise transmission capacity. New systems and services that exploit these technologies are anticipated soon.

In June, Motorola announced plans to orbit a constellation of 77 small satellites for a global cellular telephone system named Iridium. The first two test satellites are planned to be launched by Pegasus in 1992, and the entire system is expected to be in place by 1995.

Iridium will not be without competition. In July, Starsys, a French company backed by its government, filed with the Federal Communications Commission its intent to put in place a system named Starnet consisting of 24 low-orbiting satellites furnishing 24-hr position determination and two-way communications. Eventually the system will offer voice interconnection through the public telephone network and possibly electronic license plate monitoring for intelligent highways.

Less elaborate domestic mobile satellite services are available today. Two systems furnish two-way data communications and location for mobile users on land, primarily the long-haul trucking industry. Geostar uses Loran-C to determine the location of the mobile unit. Position information and user messages are transmitted through a GTE Spacenet satellite relay to Geostar Central, which reformats and transmits the information to the user's home office. Outbound messages are relayed through central by satellite. Geostar will later add satellite ranging.

The competing system, OmniTRACS, is operated and manufactured by Qualcomm. OmniTRACS uses readily available Ku-band satellite transponders. An Automatic Satellite Position Reporting System gives independent satellite ranging to complement Loran-C. Both systems are expanding into Europe and Japan and expect to go worldwide eventually.

Architectural studies for the next generation of military communications satellites have set a course toward operation in the Ka-band and use of smaller satellites. DARPA awarded 13 lightsat contracts emphasizing technologies for small, cheap, orbiting spacecraft. Debate on the future course of the Defense Satellite Communications System centers around the method of moving to extremely high frequency while continuing service at super high frequency under constrained budgets. Very small aperture terminals, including man-portable terminals, may be introduced for the lower band.

The most ambitious and expensive new satellite system, the Military Strategic, Tactical, and Relay Satellite system, is well along in development. Congress is wrestling with its fate. If deployed, it will afford the most durable satellite communications available, able to survive the physical, electromagnetic, and atmospheric hazards of a nuclear war.

NASA's ACTS, scheduled for launch in 1992, will be made available free in order to prove and gain acceptance for the technology employed on board. This offer will be extended for at least two years to any U.S. organization willing to procure ground stations being developed by Harris with NASA funding. The cheapest station will cost about $ 250,000 including all terrestrial interface equipment. Higher capacity stations are being developed.

Four stations are committed. All will be made available free to experimenters from surrounding academic institutions to conduct scheduled experiments. Information on the ACTS Experiment Program is available from the Public Service Satellite Consortium at NASA-Lewis, and GE Astro Space Div.

Satellites of three generations will be used by Intelsat in the '90s. The fleet will include Intelsat V/V-A, Intelsat VI, and Intelsat VII, as well as a Ku-band-only high-power satellite to meet the needs of television. Steady improvements made in pace with growing traffic demands have resulted in enviably high reliability and continuity of global service, over 99.97%.

1990 Aerospace America, December, 1990

Hughes Aircraft's first Intelsat VI satellites are going into service over the Atlantic basin. With 38 transponders at C-band and 10 at Ku-band, and sixfold frequency reuse at C-band and twofold reuse at Ku-band, each Intelsat VI has over 3,000 MHz of usable bandwidth. VI's most innovative technology is the onboard microwave integrated circuit switch matrix, which will be able to make connections among the six transponders.

Five Intelsat VII satellites are under construction by Ford Aerospace. Intelsat VII features 26 transponders at C-band and 10 at Ku-band. With fourfold frequency reuse at C-band and twofold frequency reuse at Ku-band, the usable bandwidth is 2,432 MHz. This bandwidth can be used with smaller Earth station antennas because transponder power is higher than for Intelsat VI.

Efficiency of smaller Earth stations is also increased by use of solid-state power amplifiers with power up to about 30 W for all C-band transponders and by the use of linearized traveling wave tube amplifiers at Ku-band.

Although primarily relying on analog transmission until now, Intelsat has offered digital transmission service for some time. The so-called SPADE system, which is demand assigned single channel per carrier transmission, has been in place since 1973 and has a complementary preassigned system. TDMA, which is inherently digital, has been operational in the Atlantic and Indian Ocean regions since 1986.

Another significant new aspect of Intelsat digital communications is the widespread application of digital circuit multiplication equipment, which multiplies channel capacity by 4-5. Use of this equipment will become more widespread as a new digital transmission standard known as Intermediate Data Rate replaces analog transmission throughout the '90s. In addition, 16-Kbps voice coding may become standard for public switched networks, which could again double the capacity for voice traffic. However, this gain may be soaked up by rising nonvoice traffic.

Comsat demonstrated that by coded octal phase-shift-keyed transmission, information could be sent to Europe at the same 140-Mbps rate as the new TAT-8 fiber optic cable through a single 72-MHz-wide transponder. Then, by the same method, it demonstrated transmission of digital high-definition television into small Ku-band Earth stations in Japan.

GRAPHIC: Picture, NASA's Advanced Communication Technology Satellite is scheduled for launch in 1992.

LEVEL 1 - 3 OF 53 STORIES

December, 1990

SECTION: Vol. 14; No. 12; Pg. 23

LENGTH: 533 words

HEADLINE: Providers mull LEOs, GEOs; Low earth orbit, geostationary earth orbiting satellites Update: 1990 Satellite Communications Users Conference

BYLINE: Covens, Lloyd

BODY:

Providers Mull LEOs, GEOs

* Las Vegas - With their eyes firmly fixed on the 1992 World Administrative Radio Conference (WARC), mobile satellite service providers are upbeat about market prospects in the 90s. Panel members at the 12th Annual Satellite Communications Users Conference debated the merits of GEO (geostationary earth orbiting) satellites versus LEO (low earth orbit) satellites, and suggested there would be fewer MSS players in operation by mid-decade.

With three system providers on line, and four waiting in the wings, the panel, representing five of the major proponents, agreed that frequency allocation in the L-band will be critical to the eventual success of the players. Several United States' MSS companies have formed a working group to propose a joint WARC position which would ask the ITU to set aside a shared block of L band large enough for all the players.

"We're living in a frequency ghetto," proclaimed Stephen Cheston, executive vice president for government affairs at Geostar Inc. Cheston said to meet market needs the MSS industry will need between 164 to 416 MHz between them, up from the 63 MHz now allocated in the high frequency L-band.

Durrell Hillis, corporate vice president and general manager for Motorola Inc.'s Iridium project said the 1992 WARC meeting will be pivotal for his firm's network. With a commitment to launch 77 low-Earth orbiting satellites to cover the earth's surface for voice communications capacity, Hillis said Motorola will need to have 700,000 subscribers to make Iridium profitable. "We will invent new things technically," Hillis said, "but maybe conceptually," he added.

Alan Parker, president of Orbital Communications Corp. said his company's LEO-based Orbcomm system will focus on the automotive emergency alert market. Parker said a $ 150 consumer terminals, and annual service fees of $ 30 to $ 50 could yield an annual market of $ 3 billion to $ 5 billion worldwide. "That doesn't mean, however, that everyone survives in the near term," Parker said.

Gary Noreen, a board member of American Mobile Satellite Corp., said corporation members have worked on mobile services for eight years, and have confidence in the geostationary approach AMSC plans to use with its proprietary satellite due for launch in 1993. Furthermore, Noreen added, "of all the proposals, only AMSC-Telesat Mobile Inc. can provide digital satellite

services."

And Qualcomm Inc., builder of the two-way data communications device used by Geostar for MSS, told attendees that the marriage of satellite communications and computerized systems will yield even greater breakthroughs.

"Maybe our vision is too limited now," offered Tom Bernard, vice president and general manager of Qualcomm's Omnitracs. "It's hard for a small group of people to really think of all the applications."

Three SCUC panels on mobile satellite service drew large crowds, with Leslie Taylor, president of Leslie Taylor and Associates, leading a session on Satellite-Personal Communications Services. "I just came from a land mobile seminar last week," Taylor said, "and the last thing they want to hear about is personal communicators which are satellite-based."

GRAPHIC: photograph

SUBJECT:
Mobile satellites in telecommunication, Marketing

COMPANY:
SIC: 4899

09194558

LOAD-DATE-MDC: June 07, 1991

LEVEL 1 - 4 OF 53 STORIES

December, 1990

SECTION: Vol. 24; No. 12; Pg. 25

LENGTH: 1641 words

HEADLINE: Wireless communications: the next wave

BYLINE: Valovic, Tom

BODY:

Wireless Communications: The Next Wave

Marconi would be pleased. Wireless communications is emerging as the most interesting development in telecommunications since fiber optics. This new technology -- or more accurately, new application for an old technology -- has the potential to yell fire in the crowded theatre that is the telecommunications marketplace. Moreover, from a wider, public network perspective, it could be the missing ingredient in what has up to now been a divestiture-induced regulatory conundrum posing the deceptively simple question: How do we open up the local exchange in the US for the kind of competition that has invigorated many other segments of the industry? (see Figure 1).

For some strange reason (namely a high level of continuous technical innovation), the telecom industry refuses to settle down. In fact, it's beginning to make the traditionally dynamic computer business look stodgy by comparison. Just as network managers are putting the finishing touches on 5-year plans that have now collapsed into 2- or 3-year plans, a new technology or standard comes down the pike with what seems to be the express purpose of decimating any reasonable approach to network planning. Want an example? Here's a good one. Just as the proliferation of standards-based LAN systems, such as Token Ring and Ethernet, were converging towards a uniform, standardized, high-bandwidth approach to local communications (i.e., FDDI), the biggest worldwide player in the cellular and radio communications business announces that they are going to develop a wireless LAN based on 18-GHz microwave technology that will deliver 15 Mbps of bandwidth to the desktop initially, but might even push the envelope as high as 50 or 100 Mbps. This was, of course, Motorola's announcement for what they are calling a Wireless In-Building Network (WIN) system.

PCN AND POINTS BEYOND

Over on the voice side, who can keep up with the rapid pace of events that have transpired since trail-blazer Millicom first asked the FCC to let them trial personal communications networks (PCNs)? Those trials are now underway in Houston and Orlando. But more importantly, a large number of other vendors are expressing serious interest, including industry heavy hitters such as Northern Telecom, Pacific Telesis, Motorola, Ameritech, and others. At last count, there were something like 15 experimental licenses granted by the FCC to companies interested in trialing the new personal communications technologies, now being categorized by some under the generic umbrella of personal communications systems or PCSs. NTI, incidentally, is lobbying for the

adoption of an industry standard which they've dubbed PCI. Northern says the standard would be compatible with both CT2 and the Canadian CT2 Plus. And speaking of CT2, Bell Atlantic is moving ahead with this country's first CT2-based Telepoint trial, and other RBOCs are sure to follow, anxious to capitalize on their growing experience with next-generation cellular systems in Europe.

In Europe, there seems to be a similarly unrelenting level of activity with respect to the acronym-laden wireless environment involving such standards as GSM, DECT, CT2, CT3, PCN, CAI, and so on. These developments seem to continue to snowball into a regulatory morass that only an editor or analyst could love. Over in the Eastern Bloc, RBOC activity shows no signs of abating, with US West moving ahead to develop a 50,000-subscriber cellular network in Leningrad, and a major network (now operational) in Hungary. And then, of course, there was Ericsson's announcement at TCA that they will develop wireless capability for their MD110 systems, using microcell technology.

No lack of activity, to be sure. However, the question remains: Will activity lead to implementation, at least here in the US? There are many obstacles. First of all, a large installed base of analog cellular systems; a severe shortage of spectrum here in the US below 1 GHz; and a regulatory environment that makes the development of state-of-the-art technology infrastructures more of a problem that a solution. Both the FCC and NTIA are trying to determine how to reallocate existing spectrum in ways that will keep everyone happy. Congressman Dingell has introduced legislation that would transfer 200 MHz of spectrum from the NTIA to the FCC for just these types of applications. However, as NTIA Chief Janice Obuchowski pointed out in a recent statement, actual implementation of reassigned spectrum will by no means be a simple task, since it will involve weighing the competing merits of spectrum currently being used by various government agencies. For those who think this problem will be solved anytime soon, Obuchowski, in the same statement, pointed out that doing this type of evaluation properly was "frankly, beyond the capacity of any coordinating agency."

A key question for the acceptance of wireless use in the office, of course, will be whether or not network managers will be comfortable enough with the new technology to eliminate wiring in new buildings. If so, the cost savings could be considerable. But, as with personal communications systems, there are some serious hurdles to overcome. Real acceptance of wireless communications in the office can theoretically be beset by three snags: interference, security, and health risk. I won't launch into a major discussion of these items here, but I will pass along the opinion of a highly knowledgeable officer of a major telecom user group who is of the decided opinion that fiber will "win out" in the office environment primarily because of the possible hazards, and perceptions of hazards, associated with item 3.

NICHE FILLER OR KILLER APPLICATION?

One application sure to generate a lot of controversy and debate is the use of wireless technology in LANs. Some companies that are very active here are NCR, with their WaveLAN product; Agilis; Photonics; Un Tied Communications, and, of course, Motorola (see Table 1). The transmission systems in use among the array of these vendors' products include infrared, spread spectrum, and standard microwave technology.

Motorola's approach is worth a special mention. Several months ago, the telecom giant had the industry buzzing with their Iridium announcement, a worldwide satellite-based cellular system which the company said would be deployed in 1995. During the week of the CMA show, the company attempted to rekindle that level of excitement with the unveiling of the WIN system mentioned above. Is WIN a winner? That depends on the degree of skepticism with which you approach the wireless LAN market in general. Some observers believe that the market for wireless communications will remain isolated to a few niche markets and will not become a significant factor in the overall LAN arena. Figures from Forrester Research, for example, suggest that wireless LANs will constitute less than 1 percent of the total LAN market by 1995. The thinking here is that wireless LANs generally will not have the bandwidth capacity to compete with technologies like FDDI, which are just now coming into their own. And indeed, technologies that rely on spread spectrum will have to live with certain bandwidth limitations. In Motorola's case, however, Tom Freeburg, a senior member of Technical Staff involved with this project, told me that 50- and 100-Mbps systems are "quite doable," and hinted that Motorola will definitely be headed in this direction with their products. In addition, other studies tend to cast the Forrester numbers in a somewhat conservative light. Research from the Yankee Group, for example, pegs wireless LAN market penetration at 6 percent of the total LAN market in 1992.

What Motorola did with WIN was basically to take a standard 18-GHz microwave platform and, utilizing GaAs and CMOS technology, downsize it to a module that is easily handheld. Coupled with what Motorola calls a "six-sector intelligent antenna," the combined transceiver is about the size of a license plate. (see Figure 2). There are no products available now and there won't be until the first quarter of 1991. The company decided to take the 18-GHz approach for several reasons. First, an FCC rule change last April now allows them to apportion spectrum for this application. Second, there's plenty of spectrum available at these frequencies since the only other use of 18 GHz is, of course, for point-to-point microwave. Third, because of the propagation characteristics of 18 GHz, the WIN system can re-use the same frequencies at a range of about 120 feet via a series of deployed, architecturally bounded microcells in the office environment. When a customer signs on to the WIN product, however, Motorola will continue to be the license holder for the duration of its use. The company claims that this will not become an administrative hassle for users, but this is certainly something to be fully investigated by any network manager considering such an option.

Summing up, on the public network side, I believe that we've seen the future of telecommunications and it is indeed wireless. Personal communications systems, whether satellite- or microcell-based, will utterly transform and revolutionize current industry infrastructures, if the regulatory powers have the requisite vision to allow a balanced market entry and transition among competing players. With respect to wireless communications in the office, things get murkier. Whether or not new wireless LANs will be able to successfully compete with fiber-based LANs and other systems is a subject that will be much debated in the next year. Thus, their ultimate role in the corporate networks of the future remains very much, at this point in time, an open question. Stay tured.

GRAPHIC: chart; Table; Caption: The evolution of wireless communications. chart; Major wireless LAN players. table; Glossary of personal communications acronyms. table

Telecommunications(c) 1990 IAC

SUBJECT:
Wireless local area networks (Computer networks), Growth

COMPANY:
Motorola Inc., Product development; SIC: 7372

09732529

LOAD-DATE-MDC: February 22, 1991

LEVEL 1 - 5 OF 53 STORIES

Network World

November 26, 1990

SECTION: TOP NEWS; Briefs; Pg. 2

LENGTH: 107 words

BODY:

Motorola seeks Iridium frequencies. Motorola, Inc. will ask the Federal Communications Commission to push for an international spectrum allocation for a low-orbit earth satellite service in the 1.46- to 1.53-GHz range at the upcoming World Administrative Radio Conference '92 next month. Motorola wants to use the frequencies for its proposed 77-satellite Iridium system, which would provide mobile voice and data services. The spectrum is also sought by advocates of another new technology -- digital audio radio services. The 1.46- to 1.52-GHz range is now occupied by members of the Aerospace and Flight Test Radio Coordinating Council.

LEVEL 1 - 6 OF 53 STORIES

Communications Daily

November 9, 1990, Friday

SECTION: Vol. 10, No. 218; Pg. 6

LENGTH: 395 words

HEADLINE: Connection With Digital Cellular;
MSS PLAYER ANNOUNCES NEW VOICE-RDSS VENTURE WITH 24 SATELLITES

BODY:

Ellipsat Corp., Washington, D.C., has filed at FCC for authority to construct Ellipso I, satellite system that would use small satellites in elliptical orbit to provide voice and Radio Determination Satellite Service (RDSS). System, which proposes to interconnect with cellular network to enable use of low-cost terminals, would compete for U.S. domestic Mobile Satellite Service (MSS) markets with Motorola's Iridium system (CD June 27 p2).

Ellipso would use 24 miniature Eyesat-class satellites to be made by Interferometrics, Vienna, Va., which is involved in joint venture with Washington-based Mobile Communications Holdings. Satellites would be in 4 elliptical orbits that would increase possible range and duration of coverage of U.S. and domestic offshore points, Ellipsat Pres. Robert Perry said. Six birds would be used to provide voice and RDSS. Company said system could be ready 2 years after FCC authorization. Ellipsat also has applied to U.S. Patent Office.

System would interconnect with digital cellular systems being tested in U.S. Ellipso would have Code Division Multiple Access (CDMA) technology, provide transparent roaming between terrestrial and satellite services. Company said interconnection would be supported by common signaling channel based on SS-7, standard adopted for advanced telephony to permit integration with public telephone network. Partners expect system to be able to offer air time charges comparable to current cellular services.

Ellipsat would be network organizer, with "value-added partners" providing service. Company said partners may include cellular companies that plan to offer subscribers extended geographical coverage in remote areas, or those serving "specialized industries." Users would receive satellite service with "add-on" device for existing cellular equipment that company said would be available at "nominal cost" or by purchasing combined satellite/cellular unit.

System is most recent in series of announcements involving MSS that plan to rely on smallsats (generally, birds weighing less than 1,000 lbs.). Closest competitor is Motorola, which plans to launch satellite-cellular system using 77 low earth orbit spacecraft. Hybrid would provide worldwide mobile services, with automatic, seamless handoffs between cellular telephones and satellites and from satellite to satellite.

LEVEL 1 - 7 OF 53 STORIES

Fortune

November 5, 1990, Domestic Edition

SECTION: TECHNOLOGY; Pg. 143

LENGTH: 1994 words

HEADLINE: THE GO-ANYWHERE PHONE IS AT HAND

BYLINE: by Andrew Kupfer, REPORTER ASSOCIATE Patricia A. Langan

BODY:

ONCE YOU GET over the initial self-consciousness and the dirty looks from people nearby trying to read the paper, there is undeniably an illicit, nerdish thrill in making a call with a portable phone while you're riding on a bus. The rush of self-satisfaction -- which comes from doing something where it previously was impossible, something that inferior gadgetless beings can't do yet -- is very much akin to the way you may have felt the first time you extracted cash from a bank machine at midnight or watched a Hollywood movie on a Betamax.

Cellular phones are leaving the auto and becoming truly portable. An estimated 40% or more of those being sold can be carried and used anywhere, and the proportion is growing. About 25% of new telephone numbers are going to cellular phones. System operators, newly licensed by the Federal Communications Commission for practically all areas still without service (see box), are filling in the holes on the map.

The phones are getting smaller, lighter, and with remarkable rapidity, cheaper. Motorola's 10.7-ounce MicroTAC came out last year at $2,495; you can get it now in some markets for $800. You can buy a car phone for a quarter of that price. As a result, industry experts believe subscribers could grow from almost 4.4 million today to 25 million by the end of the decade.

Yet the profusion has bred confusion, and not a little disillusion. Users are often dismayed by signal quality, especially in big cities and at the edges of service areas. Batteries on the smallest phones allow less than an hour and a half of talk time between charges, and in the case of the MicroTAC, only 30 minutes. Monthly bills can be stunning, averaging about $85 but far higher for subscribers who use their phones away from their home city -- system operators hit outside users with extra charges. And every month, it seems, companies announce plans for a new type of service that will be cheaper, or permit featherweight phones, or span the entire globe via satellite -- but that won't work with phones on the market today. One prominent operator, Craig McCaw, even suggests -- at least half-seriously -- that the government reserve radio spectrum for mental telepathy service.

For prospective cellular junkies afflicted with consumer's paralysis, some reassurance: Chances are slim that the phone you buy today will become obsolete tomorrow. Precisely because of such fears, cellular operators and equipment makers have agreed that whatever new services come into play, the existing network will remain compatible with today's phones for as long as they are likely to last. The basic network will continue to grow, making it easier to

1990 Time Inc., Fortune, November 5, 1990

place and receive calls. Anyone hankering after portability soon should not be overdazzled by things to come; most of the new technologies have yet to prove themselves and are at least several years away.

A CELLULAR PHONE is really a radio. Service providers divide their areas into cells, each with equipment that transmits calls over a slice of the radio spectrum. As a user moves, the network hands a call in progress from cell to cell, each of which has a range of 25 miles on average (less in cities). The cells send calls by radio to a mobile telephone switch, which feeds into the land-line telephone network by wire or microwave. Subscribers to cellular phone service receive a seven-digit local telephone number. Electronics dealers like Radio Shack program the number into the phone at the store.

With four types of phones to choose from (see table), buyers should consider what they will be doing when they want to make their calls. The best choice for heavy drivers is the mobile telephone, or car phone. It delivers the most powerful signal but it is tied to the vehicle with a separate transceiver, usually mounted under a seat. Some luxury cars offer hands-off operation and sound coming through the hi-fi speakers. Gee-whiz versions have limited powers of voice recognition ("Call Dave!" or "Hang up!" you may command).

For users who need to take their phone from car to car -- or from car to construction site or sailboat -- a good option is a transportable phone. Consisting of a handset and a somewhat bulky transceiver and battery, the transportable can draw power from either a car's cigarette lighter or batteries and puts out a signal as strong as a mobile phone's. It weighs at least 4 1/2 pounds, unwieldy for slinging into an overnight bag. Its batteries are good for three to five hours of active use.

The so-called bag phone is a mobile unit packaged by retailers in a carrying case and sold as a transportable. It is cheaper and easier to carry, but manufacturers say in many cases the components are not shielded well enough to operate in close proximity to each other without causing interference.

Peripatetic people prefer hand-held portables. These combine transceiver, antenna, and battery in a single unit resembling a walkie-talkie with push buttons. The phones weigh no more than 1 1/2 pounds or so; the lightest, just introduced by Mitsubishi, weighs only 10.4 ounces. Generally, the lighter the phone, the higher the price. Drawbacks, besides price, are lower power output and limited talk time -- rarely more than two hours per battery charge.

Cellular service is proliferating. The FCC divided the country into areas based on population patterns and has licensed two competing operators in each area -- one a local telephone company, the second an independent operator, like McCaw Cellular Communications. Most metropolitan areas have systems up and running, and networks are spreading in rural areas. The extent of service in some parts of the country will surprise the frustrated user of a couple of years ago. On the West Coast, with the exception of a few gaps, service is available continuously from Vancouver to Tijuana.

ONE HOT ISSUE is how to make life easier for roamers, industry parlance for customers who call outside their own service areas. Most cellular companies have reciprocal arrangements that let roamers make calls just by dialing. Where roaming agreements are not in force, an operator may break in and ask for a credit card number for billing, but that sort of inconvenience is becoming the

1990 Time Inc., Fortune, November 5, 1990

exception.

Operators sock roamers with costly charges -- $3 a day for access and extra per minute rates. In the New York metropolitan area, for example, Nynex charges 75 cents a minute for local calls and Lin Broadcasting 85 cents, vs. the 50 cents and 45 cents on average that regular subscribers pay. Long-distance tolls are added, too, for calls out of the area.

Receiving calls has been a bigger headache for roamers, but a breakthrough promises relief in several years. Today a roamer's home network may not be able to forward calls to another system; cellular switches made by different manufacturers can't always talk with one another. Callers must then know where the roamer is and dial a cumbersome code to gain access to the host company's network. This impediment should disappear by mid-decade. The industry has agreed on software standards that will allow heretofore incompatible switches to communicate. Until then, some operators offer a voice mail service that will store messages for customers who are out of reach.

A new generation of equipment will help operators add the capacity frustrated urban subscribers desperately need. At peak times in New York (midday is the worst), some 20% of calls don't get through on the first try because the system is filled to capacity. In Seattle, by contrast, only about 2% of peak calls are delayed. A cellular company usually increases capacity by dividing its area into a greater number of smaller cells. When transmitters are packed too tightly together, as in big cities, calls in adjacent cells begin to interfere with one another. Calls are also more likely to be lost as cars move from cell to cell. Says Bob Keller, chief operating officer of Nynex Mobile Communications: "None of us is providing the service we want in metropolitan areas."

Today's systems are based on analog technology that essentially sends electronic versions of voice patterns over the air. Next year the industry will begin to phase in digital equipment that translates sound patterns into computer codes. Digital radio channels can handle at least three times as many calls as analog channels. Companies then will be able to add capacity while giving urban cells the elbowroom they need. The drawback for consumers: Initially, the requisite phones will be bigger and heavier and cost 10% to 15% more than present-day analog phones. Price subsidies from operators are a likely inducement. The industry promises to protect owners of old phones by keeping analog channels during an unspecified transition period.

A little further in the future of the strained urban networks are plans by operators -- some of whom already run cellular systems -- to build low-priced "pedestrian networks" for use by people carrying cheap, ultralight phones. Under such rubrics as Personal Communication Networks or Personal Telephone Services, the systems will have closely spaced cells and use low-powered transmitters. The digital systems will tag the signal between cell and handset with a unique code; each phone will be able to "hear" only the signal that bears its code. Nynex plans to start building a system in Manhattan next year. A joint venture of Washington Post Co. and American Personal Communications plans an experimental system this year in Washington.

On the far horizon of space and time -- and perhaps just inside the realm of credibility -- is Motorola's grand Iridium scheme to bring wireless phone service to every point on the surface of the earth. Users anywhere with a small handset would be able to beam calls skyward to an array of 77 low-orbit

satellites. Skeptics wonder if the consortium of companies Motorola is forming to run the project will receive the necessary permission from foreign governments. Costs may also be stratospheric, with $2.3 billion needed for deployment (scheduled to begin in 1994). But Motorola says the service can make money with only 700,000 subscribers worldwide.

THE IDEAL RESOLUTION of these different systems varies with the perspective of the beholder. Pushers of the new schemes see nothing wrong with a multiplicity of incompatible services, each appropriate for a different set of consumer needs. Operators with big commitments to the present network advocate compatibility, especially Craig McCaw, whose company has borrowed billions to move toward a unified national network. Says he: "Whatever we do ultimately has got to protect the customer from having a boxload of phones."

It is McCaw who floats the idea of a telepathic implant device. "It's only a matter of time," he says. "Categorically, there will be a form of telepathic communication possible with electronic impulses out of the brain. Five years from now we may know how to do it. Maybe it will be ten or 20 more years before it could be implemented." In the meantime, perhaps by the end of the decade, the national cellular network may be able to link up with the pedestrian systems now being field-tested. Most people still won't have a cellular phone by then. But most people don't have a Walkman today, and yet we would consider them ubiquitous.

BUYER'S GUIDE TO CELLULAR PHONES

Type	Price range	Features
Mobile	$200-$500	The original hard-vired car phone. Most offer hands-off operation; some provide voice recognition.
Transportable	$400-$700	Can be moved from car to car. Same power as a mobile phone. Too bulky for attache case.
Bag Phone	$100-$400	A mobile phone packed in a shoulder case. Easier to carry than transportable, but has a poorer signal.
Hand-Held	$500-$1,200	Smallest and lightest (as little as 10.4 ounces), with lower power output, limited talk time.

GRAPHIC: Picture 1, Broken phones in Manhattan don't stop a portable user. Mitsubishi's is the smallest. descColor: Mitsubishi's mobile cellular telephone., MICHAEL L. ABRAMSON; Picture 2, See above. descColor: Man using mobile cellular telephone., NINA BARNETT; Picture 3, In the city that never shuts up, hand-held phones put in appearances at an after-school program in Battery Park, a lunchtime meeting among lawyers, and the shooting of a Gene Wilder film. descColor: Three photographs: Man using mobile cellular telephone with boy on bicycle; man seated at table dialing on mobile cellular telephone with two others; woman on street using mobile cellular telephone., NINA BARNETT (3); Picture 4, An actress/stockbroker juggles engagements. descColor: Woman with dog on leash using mobile cellular telephone., NINA BARNETT

LEVEL 1 - 8 OF 53 STORIES

November 5, 1990

SECTION: Vol. 13; No. 44; Pg. 6

LENGTH: 1041 words

HEADLINE: Review of latest U.S space activities

BODY:

REVIEW OF LATEST U.S. SPACE ACTIVITIES**

The Commerce Department, in a recently released report, titled "Space Business Indicators," predicts a positive environment for the U.S. space industry in the next few years. In the report, it said the U.S. commercial launch business is the fastest growing sector of the commercial space industry experiencing an almost 400% increase in sales from $ 159 million in 1989 to $ 610 million in 1990.

Commercial sector revenues are expected to increase by more than $ 880 million, reaching $ 3.6 billion in 1990 from nearly $ 2.8 billion in 1989. This represents only those government space expenditures for commercial launch services. Net exports of U.S. satellites and launch services are expected to increase to $ 1.6 billion in 1990 from $ 1.1 billion in 1989.

U.S. Commercial Space Launch Industry Faces Foreign Competition

In 1990, 10 large capacity commercial launches are scheduled and are expected to generate revenues of $ 610 million, according to the Transportation Department's Office of Commercial Space Transportation. As of late June, there have been 4 successful commercial launches in 1990 -- 2 by a Delta 2 rocket and 2 by a Titan 3 rocket. In this period, there was also one launch failure -- a Titan 3 carrying an Intelsat 6 satellite on March 14 (SN, March 19, pp. 1-4).

The market for small orbital launch vehicles and launch services currently is driven by military contracts, said the report. In 1990, 6 launches of small expendable launch vehicles (ELVs) are scheduled with a total estimated value of $ 32 million. The market for small launch vehicles in 1991 is expected to increase to $ 60 million with 10 launches of small ELVs. Five commercial launches are scheduled with a value of more than $ 10 million. Most of the small orbital launch vehicles that are marketed for commercial users have prices ranging from $ 8-20 million.

International competition is increasing in the market for medium and large launch vehicles. The fiercest competitor for the U.S. commercial launch industry is Arianespace which currently holds about half the market for commercial payloads.

Because of delays in its launch schedule following a launch failure in February, Arianespace expects 6 launches in 1990, compared with 7 launches of 10 satellites in 1989 (SN, Feb. 26, p. 4). Launch revenues were $ 631 million in 1989.

Satellite News (c) 1990 IAC

China is a relatively new competitor in the international space launch market. In April, a U.S.-built communications satellite was successfully launched on the People's Republic of China Long March 3 booster for AsiaSat (SN, April 16, pp. 4-5). China has contracts to launch 2 U.S.-built satellites purchased by Australia in 1991 and 1992.

In 1989, China signed a voluntary restraint agreement with the United States limiting it to a total of 9 launches of satellites from Western nations through 1994. Also, Japan is developing a large capacity launch vehicle, the H2, scheduled for operation in 1993.

U.S. Satellite Communications Industry Experiences Growth in 199 0

The U.S. satellite industry is expected to produce 9 satellites for commercial use in 1990 -- all are for the export market with an estimated value of $ 1 billion. Worldwide, there are 51 satellites on order for delivery in 1991-93, with the United States accounting for 57% of worldwide orders. France has the next largest share of prime contracts, 17%, followed by the United Kingdom with 10% of world contracts, said the study.

An emerging market for satellite manufacturers is small, low-cost satellites, called lightsats. This market, dominated by military contracts, produces satellites that range in size from 150-1,000 pounds and cost $ 2-5 million. Potential commercial markets for lightsats include small communications satellites (3-10 transponders) in geostationary orbit and systems of 20 or more satellites in low orbit for mobile satellite services (MSS). Recent proposals to the FCC system, Motorola Inc.'s Iridium project, and Afrispace Inc.'s Afristar satellite (SN. Aug. 6, pp. 1-3; June 11, p. 3).

Satellite operating companies are projected to generate revenues of $ 800 million in 1990 from leasing 482 transponders on 27 communications satellites serving the U.S. domestic market. Two domestic satellites were returned from full-time service in 1990, temporarily reducing transponder capacity from 520 in 1989 to 482 in 1990. However, several replacement satellites are scheduled for launch in 1991. Nearly 60% of the revenues from satellite transponders leasing are generated by video programming from the major broadcast networks and cable TV networks.

Ground station equipment for sending and receiving satellite signals is the fastest growing satellite-related industry and shipments are expected to increase to $ 850 million in 1990 from $ 750 million in 1989, said the report.

Revenues from the mobile satellite service providers are expected to reach $ 60 million in 1990. Communications for aircraft on trans-Atlantic and transPacific routes will begin in 1990 with low-speed data and voice in 1991.

Report Says Space Insurance Costs Seem to Have Leveled Off

Insurance is an essential element of the development of space commerce because of the inherent risks in space transportation and the large amounts of capital at risk in each satellite launch, said the Commerce Department. Space insurance includes property damage -- designed to cover the value of the launch vehicle and spacecraft from launch through initial operations (it may also include annual coverage for commercial operations); and third party liability -- designed to cover injury or damage to parties other than those associated with

the payload and vehicle from launch activities.

Insurance rates for property damage to launch vehicles and spacecraft were declining at the beginning of 1990, but leveled off after the loss of 2 insured satellites onboard the Ariane booster in February. Rates for communications satellites, which average about $ 100 million in insured value, are currently in the range of 16-20% of payload value. The amount of available insurance coverage, called capacity, for a typical launch and payload is about $ 250 million, said industry sources.

GRAPHIC: graph; Caption: World space launches, by country: 1989-90. graph; World communications satellite orders scheduled for delivery: 1991-93. graph

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LEVEL 1 - 9 OF 53 STORIES

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BYLINE: Stephens, Guy M.

BODY:

OSC: Reduces The Cost Of

Using Space

In 1982, while at Harvard Business School, David W. Thompson and two partners discovered a gap in the space shuttle's capability to launch satellites weighing between 5,000 and 10,000 pounds into transfer orbits.

Thompson's goal was to bring the benefits of space down to earth by reducing the cost of using space. So, he and his partners, Bruce Ferguson and Scott Webster, decided to develop an orbit transfer rocket to serve the market not covered by the shuttle and to reduce prices.

The rocket, was named the transfer orbit stage (TOS). TOS could be used by industry to launch commercial communications satellites, by NASA to launch scientific probes and by DOD to launch military satellites. The key technology in TOS, the solid propellant rocket motor, had already been qualified by NASA and the Air Force. OSC's analysis indicated that TOS could be developed for an investment of less than $ 50 million.

OSC produced a business plan, obtained seed capital financing, secured contracts with key manufacturers, assembled a management and engineering team and negotiated an agreement with NASA to gain access to government expertise and technology. The next three years of OSC's existence (1983-1986) were focused almost completely on TOS. OSC also signed NASA as its anchor tenant customer.

Today OSC is a space technology company that designs, manufactures, operates and markets a broad range of space products and services. And Thompson is president and CEO of a company with $ 97 million in total assets. Although most readily identified by its space transportation systems such as TOS, Pegasus and Taurus, OSC also produces suborbital launch vehicles, meteorological rockets, satellite tracking and telemetry systems, spacecraft systems, space instruments, and atmospheric environmental monitoring products.

In the environment in which it has chosen to exist, OSC is, by comparison, a small company with an entrepreneurial culture. Short time turn-around and low costs, Thompson says, give it the edge over most large corporations. "For example, less than three years elapsed from the time OSC conceived Pegasus until it was launched successfully in April of this year, and only $ 45 million or so was invested in its development," Thompson explains.

OSC has a broad base of government and commercial customers, the largest of which are NASA and DOD, including the Air Force, DARPA, SDIO and the Army. The company also supplies products and services to NOAA and other federal agencies, to a variety of universities and corporations and to customers in nine other countries.

In its early years, OSC followed a traditional approach for financing a high-technology start-up firm. First it obtained about $ 300,000 of seed capital from individual investors, then came a $ 2 million equity investment from a group of venture capital firms. Finally, $ 50 million was raised using a research and development limited partnership for the project financing of TOS.

OSC also has established strategic partnerships with key industrial partners. For example, Hercules Aerospace Company became a joint venture partner on the Pegasus project, funding the development of the three new solid propellant rocket motors and other equipment. OSC also raised approximately $ 32 million of equity in a private investment by Hercules to fund the remainder of the Pegasus development expenses and to acquire its Space Data Division in 1988.

In April 1990, OSC became a public company with an initial offering that raised $ 18 million in new capital.

Still branching out, OSC has entered the mobile satellite field. The ORBCOMM project will operate a constellation of 20 low-Earth orbiting satellites to provide mobile, low-cost messaging, tracking and data collection services to subscribers around the world. Early this year, ORBCOMM filed an application with the FCC to initiate a rulemaking proceeding to allocate spectrum for its service, and at press time, OSC was still preparing to launch a prototype satellite under an experimental license late this year.

In addition to the ORBCOMM system, OSC is evaluating a number of commercially-oriented space products and services in the communications, Earth observation/remote sensing and microgravity areas.

Thompson believes OSC is well positioned to survive in today's ever changing business climate. "OSC's growth does not depend on any single segment of the space industry," says Thompson. "We have a good balance between civil and defense applications of our space products and services, and we are making excellent progress with products such as Pegasus and ORBCOMM." Thompson also believes any slowdown in civilian and space activities could help OSC because of its focus on small, inexpensive space systems.

"We provide high value for low costs, exactly what we think the space market will increasingly demand in the 1990s," he says.

Emerging markets for small satellites, small launch vehicles and related ground equipment, he says, will propel OSC ahead. "The systems exhibit a level of affordability and ease of use that makes them attractive to a much larger and more diverse customer base," he says.

Thompson cites ORBCOMM and Motorola's Iridium mobile telephone communications system as excellent examples of near-term potential for what he calls microspace systems.